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CANADA AGRICULTURE

FALL 1975
AUTOMNE 1975

Canadian farmers worked long hours this year to harvest a large crop of grain that will help to replenish world food reserves.

Grâce aux longues heures passées à la récolte par les céréaliers canadiens, les réserves mondiales seront améliorées.

CANADA AGRICULTURE

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BETTER USE OF FORAGE FOR BEEF

D. W. MacDONALD

Des recherches menées à la Station de recherche de Melfort cherchent à rendre les fourrages plus compétitifs par rapport aux autres sources de provendes. Les pertes lors de la récolte et de l'entreposage doivent aussi être réduites.

Next to trees, grasses (and clovers) are the most abundant renewable natural resource in Canada. Grass grows almost anywhere in soil in a temperate climate where there is more than 13 cm (5 in.) of rain during the growing season, and if not crowded out by deeper rooted trees and bushes. In a country the size of Canada, the grass resources are tremendous. Do we have the incentive to improve and use them?

Grasslands conserve and improve the land. They also add beauty to the country and provide areas for recreation. But forage has the greatest potential as a basic source of protein for a hungry world. Fed through ruminants, forage is converted to high quality protein in the form of milk, cheese, beef and lamb. Of 69 million ha (148 million ac) in occupied farms in Canada, about 10 million ha (25 million ac) are cultivated for hay and pasture, and 20 million ha (50 million ac) are in rangeland. Forage is not cultivated on more land apparently because it is more profitable to grow other crops. And vast acreages of grass in more inaccessible places go to waste as a food source because of the low returns to this type of management.

Scientists at Agriculture Canada's Melfort, Sask., Research Station believe that forage crops can be more competitive. In the Parkland area of northeastern Saskatchewan, farmers produce wheat, barley, oats, flax and rye. In recent years, the acreage of rapeseed has increased significantly because of its adaptability and performance on the deep rich soils. Cropping programs are diversified to some extent by forage production. However, it is believed that livestock production based on improved forages would help stabilize the economy, and make use of byproducts of the cereal and oilseed industry.

For good performance on high forage rations, the ration's bulk should be reduced by grinding. In most cases, grinding through a screen with 13 mm (½ in.) diameter openings has resulted in optimum feed utilization and animal performance.

Dr. S. E. Beacom, Director, Research Station, Melfort, gives a number of reasons why farmers should grow forages:

- Forage traditionally supplies 62 percent of the energy for milking cows, 80 percent for other dairy cows, and 30 percent for fattening beef cattle and sheep. He adds that forage can make up 65-95 percent of the beef finishing ration provided the quality is high.
- Forage improves the structure of soils, binding particles together to resist erosion. The legume component adds fertility in the form of nitrogen. Much of the fertility in forage is returned to the land as manure.
- Properly managed forage stands produce for many years, saving the cost of cultivation, and annual seeding.
- Forage is not as susceptible to frost damage or delays in seeding as cereal and oilseed crops.

Mr. MacDonald is Head, Periodicals Services Unit, Information Division, Ottawa

- The need for fertilizer can be reduced by growing nitrogen manufacturing legumes in grass mixtures. While 34-100 kg of N/ha (30-90 lb/ac) may be required on cultivated grasses in Saskatchewan, no additional N is required for legumes. Recent work indicates that they may respond to an application of phosphorus fertilizer.

Continued drought in the 30's drove farmers off the land in southern Saskatchewan and many moved north into the Parklands where rainfall was more dependable. In 1935, Agriculture Canada established an experimental farm (now a Research Station) on the deep black soils at Melfort. Gains on dryland, brome-alfalfa pasture at Melfort have averaged 274 kg/ha (250 lb/ac) compared to gains of 34 kg/ha (30 lb/ac) at Swift Current, indicating more potential for livestock in the northern area.

In 1953, emphasis was placed on better use of pasture resources at Melfort, as well as at other research stations at Lethbridge and Lacombe, Alta. The scientists soon realized, however, that if farmers were to make better use of forage, the program should include a study of the effects of harvesting, storing and processing on animal performance.

Since 1962, the objective at Melfort has been to determine the role of harvested hay in rations for growing and finishing steers and lambs. In 1970, research was also undertaken to reduce losses in forage harvesting and storage.

"The work was undertaken for two reasons," says Dr. Beacom. "First, we were concerned about the relatively small acreage of forage in the region and the detrimental effect on the productive potential of the soil. Secondly, we were concerned that the feedlot operator was becoming too dependant on cheap grain."

In western Canada, beef cattle have been finished on high energy feed grain with just enough roughage (5-10 percent ground cereal straw) to provide some protection against digestive problems. But the price of grain has increased substantially in recent years (from as low as 3 bu/$ to a high of about $2.50/bu in the case of barley).

Without a corresponding increase in the price of their product, feedlot operators who are dependant on large quantities of grain have been forced to cut back or go out of business. Feeders with facilities to handle lower cost feedstuffs, such as silage, rapeseed screenings and straw have been in a better position to weather the storm.

At Melfort, good rates of gain and carcasses of acceptable quality have been produced on rations containing more forage than is normally recommended, provided the forage is fed in the ground form. This could be of considerable economic importance to the producer who has an abundant supply of low-cost forage that may not have an alternate market.

Dr. Beacom has also found that high quality alfalfa, or alfalfa-brome hay will produce returns that exceed those attained on a high grain ration if the cost of the hay is roughly half as much per pound as grain. However, it has to be fed at a high level — 80 to 95 percent of the ration — to avoid bloat problems. With medium- and low-quality roughage, other methods must be used to improve efficiency of utilization, such as supplementation or pelleting, or varying the ration from a high level of ground forage initially to a lower level during the finishing stages.

Here is what investigators at Melfort have to say on improving forage utilization.

To determine how well wintering calves would fare on rations made up of forage alone (plus cobalt-iodized salt and water), steer calves weighing 218 kg (480 lb) were individually fed various hays and silages on an *ad lib* basis. Results showed that maximum intake of forage dry matter was about 4.5 kg/head (10 lb/head) daily and that this supported a gain of about .45 kg (1 lb). As expected, there was a strong relationship between the amount of forage consumed and the rate of gain. Daily intake of less than 3 kg (6.6 lb) of dry matter resulted in weight losses.

It was clear that some improvement in feed consumption was required if good performance on high forage rations was to be obtained. The obvious approach was to reduce the bulk of the forage. Several experiments were carried out on the effect of chopping and grinding harvested hays.

The following conclusions are based on research results to date:

- As the density of forages is increased, due to grinding or pelleting, intake of forage and rate of animal gain is increased. Liveweight gain per tonne of hay is usually increased, but may in some cases decrease if forage is ground finer than through a 13 mm (½ in.) diameter screen.
- Grinding poorer quality forages results in a greater increase in feeding value than is the case with good quality forages. Steers fed ground, poorer quality hay can often do as well as, or better than, steers fed the better quality hay in the long form.
- In most cases, grinding through a screen with 13 mm (½ in.) di-

Dr. Beacom has demonstrated that ground forage can produce good rates of gain in beef cattle.

ameter openings resulted in optimum feed utilization and animal performance. However, with hays of excellent quality, coarser grinding or chopping gave optimum results.

- Excellent rates of gain can be obtained on ground good quality hay alone. Best gains attained so far have been 1.12 kg/head/day (2.47 lb) on a ground timothy-alfalfa hay containing 13.6 percent crude protein. Steers had free access to cobalt-iodized block salt and water.
- In order to benefit from grinding hays, steers must be permitted to eat all the feed they will voluntarily consume. Merely grinding the hay does not increase its feeding value per se.

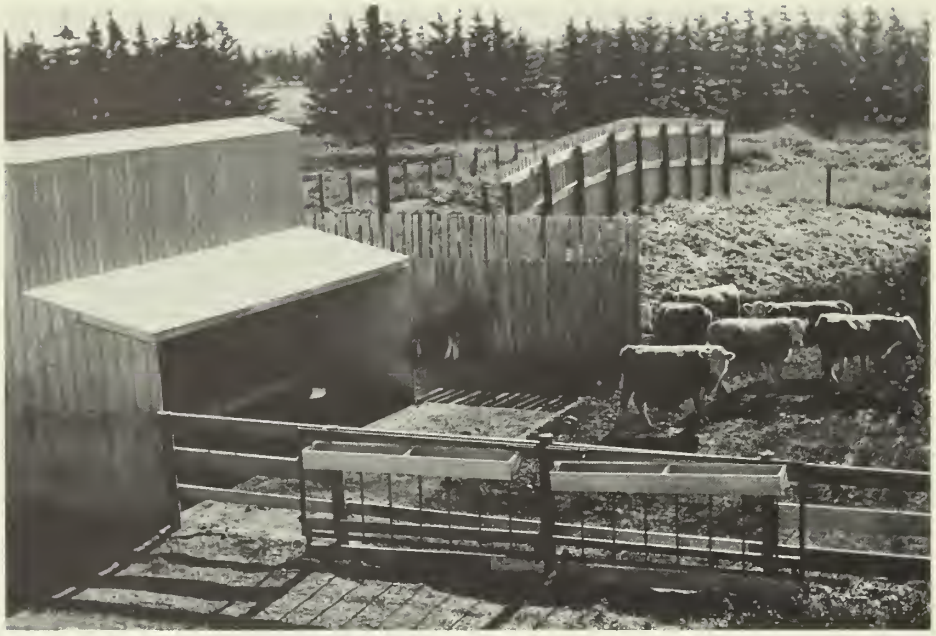
Dustiness will vary with moisture content, kind of hay and particle size. But it has not been a problem in experiments with steers at Melfort. Research on feeding moistened, ground hays to lambs, however, did reveal that moistening increased rate of gain by as much as 57 percent and feed efficiency by as much as 27 percent when a dusty, low quality, ground forage was fed.

Further work on the effects of adding water, molasses, tallow or oil to ground hay rations and pelleting ground hay rations is required with steers.

Steer Finishing

The following are Dr. Beacom's tentative recommendations to feeders on using forages more effectively in steer finishing rations:

- Feedlot operators must be in a position to use all sources of feed available to them for lowest-cost rations. To use roughages efficiently, they require a rugged grinder-mixer and a 100-HP (75 kW) tractor to grind whole bales and mix the ground roughage with grain and other supplements. A mixer equipped with a hammermill to take full bales and a roller to process the grain is recommended.
- Avoid using ground, good quality alfalfa or alfalfa-brome hay at levels of 35-65 percent of rations containing high-energy grains. When changing from high to low levels of hay during the finishing period, either dilute the hay with ground straw or use a grass or poorer quality hay.
- When formulating rations using ground hay and grain, check the protein levels of the ingredients. If the ration contains less than 10½-12 percent protein (depending on hay: grain ratio and quality of hay and grain), it may be economically sound to raise the CP level by adding protein supplement.
- If roughage is limited or grain is cheap in relation to hay, use ground hay in the early stages of the feeding period at at least 50 percent to assist animals safely onto feed, and then gradually reduce to 10 percent and replace with ground 2.5 cm (1 in.) straw.
- If roughage is limited and grain cheap, and if steers are light or have a tendency to finish at too light a weight, use roughage (50-70 percent) in rations to promote growth rather than fattening during the first part of the feeding period. Then switch to a high-grain ration so that the animals will be finished within 100 days. There is some evidence that feeding high-grain rations for more than 100 days leads to increased liver and rumen damage and poor performance.
- When good quality hay is plentiful and cheap in relation to grain, feed at a high level (80-95 percent) for as long as good rates of gain are obtained (1.2 to 1.4 kg/head/day or 2.6 to 3.1 lb). Increase the level of grain fed gradually, as required to maintain gains, watching for bloat once the level of hay drops below 65-70 percent. Unless grain is very expensive, it is probably advisable to feed at least a 50 percent grain ration for the last 3 weeks of feeding.
- When hay is plentiful and cheap in relation to grain, but quality is poor to medium: grind through a 13 mm (½ in.) screen; start with levels of 60-80 percent; use a protein supplement if required; and gradually increase the level of grain, as required to maintain



Rations containing more forage than is normally recommended have produced good rates of gain and carcasses of acceptable quality at Melfort.

satisfactory rates of gain.

- Grind hays through a 13 mm (½ in.) screen. Coarser grinding of high quality hay may be adequate sometimes, but difficulties may be experienced in keeping hay and grain mixed during augering or self-feeding which could lead to digestive disturbances. When roughage is fed at a low level or for a short period, coarser grinding helps prevent digestive disturbances associated with high grain rations.
- Always use a growth promoting implant. There may be more benefit when rations containing high levels of good quality, ground grass hay are fed rather than high energy rations. But in both cases, their use should be profitable.

Work continues at Melfort to avoid harvesting losses and improve the quality of forage for feed. Engineers from the Engineering Research Service, Ottawa, are studying the effects of harvesting methods on the amount of forage that can be preserved from a unit of land. Results to date show the dramatic effect of moisture levels at the time of harvesting. Three hundred and seventy-three kg more feed/ha (332 lb/ac) can be harvested as silage than as dry bales. This emphasizes the much lower harvesting losses in silage.

A European type of hay tower was constructed at Melfort in 1971. Hay, at up to 50 percent moisture, is stored in a cylindrical stock with a central core to allow passage of air for drying. Hay can be stored with a minimum loss of quality. Drying costs have been reduced from as high as $5.55/tonne to 60¢/tonne ($5.03/ton to 54¢/ton) by using unheated rather than heated air.

Putting up hay in giant bales and mechanically made stacks requires relatively little labor. Ability of the package to withstand weathering varies with the kind of hay, the moisture content when packaged and the skill of the operator in forming the tops of the stacks. Unless controlled feeding (use of feeding racks, feeding gates, electric wire, etc.) is practiced, wastage can be high under some conditions such as muddy ground, or feeding more than can be cleaned up quickly. ■

WHAT MELFORT SCIENTISTS SAY ABOUT GRINDING FORAGE RATIONS:

The cost of grinding hay through a 13 mm (½ in.) screen at Melfort in 1973 ranged from $2.75 to $8.80/tonne depending on the kind of hay. Such factors as quality (leaf:stem ratio) and moisture content affect grinding costs.

Grinding generally improves animal performance and feed efficiency by:

- reducing wastage associated with feeding long hay;
- increasing the density of the feed in order that the animal can consume more feed before satisfying its appetite, thus enabling a greater proportion of the feed to be used for gain;
- reducing the work associated with chewing, swallowing and regurgitating long hay;
- increasing the surface area of the feed particles, thus improving the efficiency of bacterial and protozoal action in reaching and digesting nutrients;
- promoting a more favorable ratio of fatty acids (increasing propionic/acetic acid ratio).

THE HAPLOID TECHNIQUE IN BARLEY BREEDING

G. FEDAK

La technique de l'haploïdie appliquée à l'orge permettra désormais de produire directement du matériel homozygote à partir d'un plant hybride, beaucoup plus rapidement qu'auparavant. En effet, les graines de lignées homozygotes pour l'évaluation en grande culture peuvent être disponibles 1½ an seulement après que les parents aient été ensemencés pour produire les croisements initiaux.

The time required to produce homozygous lines from crosses in a plant breeding program has been a major obstacle to progress. Homozygous lines have been produced by growing two generations of small segregating populations in greenhouses or growth chambers each winter or by utilizing a winter increase nursery in southern latitudes. A haploid technique is now used in barley *(Hordeum vulgare)* that will produce homozygous material from a hybrid plant in a single-step process in a much shorter time than other methods.

The crossing of a wild diploid perennial relative, *H. bulbosum* L., onto an F1 hybrid of cultivated barley results in the selective elimination of *bulbosum* chromosomes. This leaves a haploid embryo with the chromosome complement of *H. vulgare*. At 14 days after pollination, before the seeds mature, the embryos are dissected out and plated on an artificial medium composed mainly of sucrose, vitamins and growth regulators. A reasonable proportion of these embryos grow to produce haploid seedlings. After doubling by treatment with colchicine, they become diploid and homozygous lines.

Haploid seedlings grow on a culture medium in a vial.

Sixty doubled haploid lines were evaluated in replicated yield trials in Ottawa in 1974 and compared to the current cultivars Conquest, Vanier and Trent. Twelve lines equalled or exceeded the best check cultivar for yield and another 13 lines exceeded the average of the three check cultivars (Table 1). Some doubled haploid lines had better agronomic characteristics. Fifteen lines equalled or exceeded the best checks for kernel size, five for hl weight, and 14 were earlier than the earliest check. These results indicate that it is possible to select in either direction for the parameters required, with the added advantage of performing the selections on homozygous material.

A typical, though possibly condensed, time schedule for producing homozygous lines with the haploid technique in barley is shown below. This scheme would require a full time technician, the use of growth chambers or greenhouses to produce initial doubled seed, as well as facilities for multiplying the seed during the winter.

Seed of homozygous lines can be available for field scale evaluation within 1½ years from the time the parents are planted to produce the initial crosses. Stated in another way; within two years from the same starting point, yield data can be obtained on homozygous lines. ■

SCHEDULE FOR PRODUCING HOMOZYGOUS LINES WITH THE HAPLOID TECHNIQUE

Grow parents to produce F1 hybrid	Jan. 1975
Grow F1 hybrid plants and pollinate with *H. bulbosum*	April 1975
Culture haploid embryos; double the chromosome number and grow doubled haploids to maturity	July 1975
Increase seed of the doubled haploids in a winter nursery	Oct. 1975
Plant replicated yield trial of homozygous lines in field	May 1976

TABLE 1 NUMBER OF DOUBLED HAPLOID LINES THAT EQUALLED OR EXCEEDED CHECK CULTIVARS FOR YIELD AND AGRONOMIC CHARACTERISTICS

Test section	Yield		Kernel size	hl wt	Early maturity	No. D.H. lines evaluated
	≥ best check	≥ av check				
A	4	4	6	5	10	30
B	8	9	9	0	4	30

Dr. Fedak is a research scientist at the CDA Research Station, Ottawa, Ont.

THE FARM CREDIT CORPORATION

LOUISE NEVEU

Some 11,000 Canadian farmers received financial assistance from the Farm Credit Corporation (FCC) in 1974-75. This represents just over $413 million. Most loans were for the purchase of land to add to existing farms and for transferring farm units. This reflects the general lending pattern in the country with a new emphasis on transferring complete farms and increased demand for credit to help farmers take advantage of improved production techniques.

The Farm Credit Corporation helps farmers, and those who wish to become farmers, develop profitable farm enterprises. Farmers have access to a number of options under the Farm Credit Act, the Farm Syndicates Credit Act and the Small Farm Development Program.

A credit advisor counsels borrowers if needed. This allows FCC to monitor the progress of the farm enterprise.

Un conseiller en crédit agricole donne des conseils à ceux qui les demandent. Ceci permet à la SCA de guider les progrès de l'exploitation.

The Farm Credit Act

There are four kinds of loans that can be made under this legislation.

Standard Farm Loan (Part II) To qualify, a borrower must be of legal age to enter into a mortgage agreement and must be farming or planning to go farming very shortly.

There are a number of factors which determine how much an individual can borrow. First, the applicant must demonstrate the ability to manage the farm enterprise and repay the loan. The maximum loan can be up to $100,000 as long as this sum does not exceed 75 percent of the appraised value of the land and buildings being mortgaged. The appraised value is determined by the credit advisor and reflects the productive value of the farm enterprise in relation to its ability to produce income and in relation to similar enterprises in the area.

Loans to Persons Under 45 (Part III) The borrower must meet the basic requirements of the Standard Farm Loan and be under 45 years of age. Borrowers may obtain $100,000 or 75 percent of the appraised value of the land, buildings, livestock and equipment, whichever is the lesser. The addition of livestock and equipment allows a borrower to mortgage more of his (her) holdings, as long as the loan remains within the borrower's management and repayment abilities. The credit advisor supervises or counsels all borrowers with loans exceeding 75 percent of the appraised value of land. This guarantees assistance to the farmer if needed and allows FCC to monitor the progress of the farm enterprise.

Farmers with supervised loans must keep adequate accounting records. FCC encourages these farmers to use Canfarm services.

Loans to Persons Under 35 (Part III) A person under 35 years of age, who meets the initial requirements of the Standard Farm Loan and demonstrates ability to manage a farm enterprise, can borrow up to $150,000. Provision has also been made for the younger person with relatively little capital. FCC may lend up to 100 percent of the market value of the land, livestock and equipment, not exceeding the $150,000 limit or the repayment ability of the borrower. The market value reflects the current price for land in the area.

Loans for Persons Phasing into Farming (Part IV) Recent amendments to the Farm Credit Act make

Louise Neveu is Chief, Information Division, Farm Credit Corporation, Ottawa.

LA SOCIÉTÉ DU CRÉDIT AGRICOLE

LOUISE NEVEU

En 1974-1975, quelques 11 000 agriculteurs ont emprunté un total de plus de $413 millions de dollars de la Société du crédit agricole (SCA.). La majeure partie de ce montant a été affecté à l'achat de terres destinées à agrandir les exploitations et à l'achat de fermes. Cette tendance se manifeste dans l'ensemble du pays et démontre l'importance que prend l'achat de fermes complètes, et la demande pour du crédit devant servir à appliquer les dernières techniques de production.

La SCA. aide les agriculteurs, ainsi que les aspirants-agriculteurs, à aménager des exploitations agricoles rentables en leur offrant un certain nombre d'options en vertu de la Loi sur le crédit agricole, de la Loi sur le crédit aux syndicats agricoles et du Programme de développement des petites fermes.

Louise Neveu est chef, division de l'information, Société du crédit agricole, Ottawa.

La loi sur le crédit agricole

Celle-ci offre quatre types de prêts.

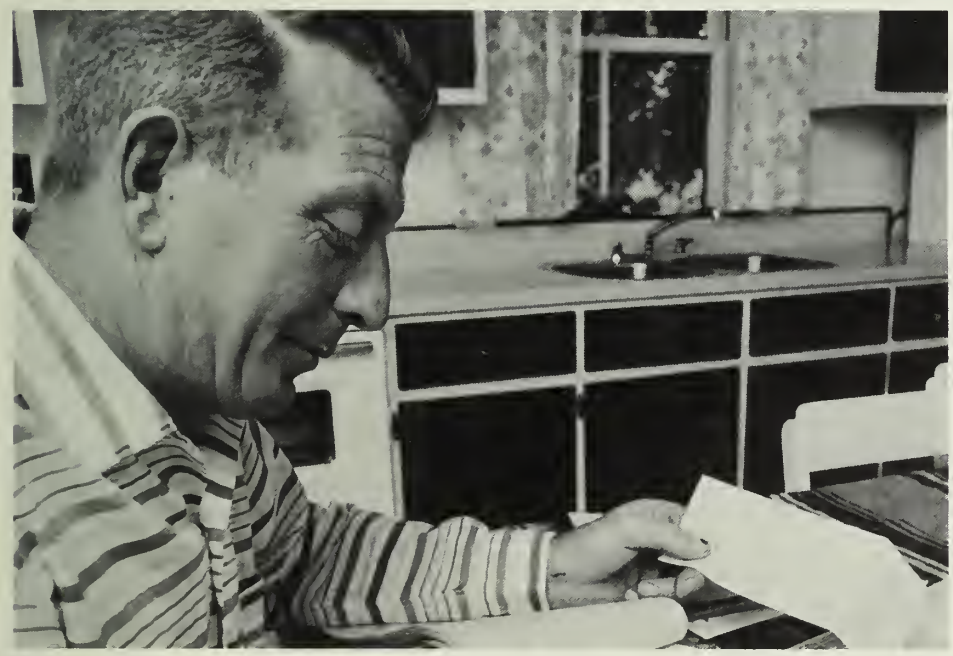
Le prêt agricole régulier (Partie II) Pour être admissible à ce type de prêt l'emprunteur doit avoir l'âge légal requis pour obtenir une hypothèque et être principalement occupé en agriculture ou le devenir sous peu.

Un certain nombre de facteurs déterminent le montant que peut emprunter un requérant. Premièrement, celui-ci doit démontrer qu'il possède les aptitudes voulues pour gérer l'entreprise agricole et rembourser le prêt demandé. L'emprunt peut atteindre $100 000 en autant qu'il n'excède pas 75% de la valeur estimative des terres et des bâtiments hypothéqués. Cette valeur est déterminée par le conseiller en crédit. Elle est fondée sur la valeur productive de l'exploitation, c'est-à-dire le potentiel de revenu établi d'après des entreprises similaires de la même région.

Le prêt aux personnes de moins de 45 ans (Partie III) L'emprunteur doit répondre aux mêmes conditions que pour un prêt régulier, et doit en plus être âgé de moins de 45 ans. De plus, son emprunt est limité au montant le plus faible entre $100 000 et 75% de la valeur estimative des terres, des animaux et de l'outillage. L'inclusion des animaux et de l'outillage dans l'hypothèque lui permet d'atteindre ce montant pourvu que ses capacités de gestion et de remboursement soient suffisantes. Lorsque le montant du prêt excède 75% de la valeur estimative de la terre, le conseiller en crédit est chargé de surveiller le compte et de conseiller l'agriculteur. Il peut ainsi lui apporter l'aide dont il a besoin et est en position de suivre le progrès de l'exploitation.

Tout agriculteur qui détient un prêt surveillé doit tenir des livres de comptabilité appropriés. La Société encourage ses emprunteurs à se prévaloir des services de CANFARM à cette fin.

Le prêt aux personnes de moins de 35 ans (Partie III) Une personne qui est âgée de moins de 35 ans peut emprunter jusqu'à concurrence de $150 000 lorsqu'elle satisfait aux conditions initiales du prêt régulier et démontre qu'elle est capable de gérer une entreprise agricole. Les jeunes gens qui disposent d'une faible mise de fonds initiale peuvent emprunter jusqu'à 100% de la valeur marchande des terres, des animaux et de l'outillage, sans toutefois excéder $150 000, pourvu que leur capacité de remboursement soit suffisante. La valeur marchande est



Farmers are required to keep accurate, up-to-date farm accounting records.

Les cultivateurs doivent avoir une comptabilité juste et à jour.

it possible for a person under 35 years of age to take up to 5 years to phase into farming. The borrower may obtain up to $150,000, not exceeding 100 percent of the market value of the land, livestock and equipment. This permits people under 35 to earn off-farm income while they develop a sound commercial farm business that will be their principal occupation within 5 years.

Applicants must provide a detailed plan for developing and operating the farm before they can qualify. They also must show that the farm income will grow to support the applicant and his (her) family. This implies knowledge and experience in the type of farming proposed. The application must also show that the transitional period is needed for financial reasons. It is not open to those who have the resources to organize and develop a viable farm immediately. Supervision required for these loans can provide sound counseling for the young borrower in his (her) first years of operation.

Other Factors

FCC credit advisors analyze a number of other factors before approving a loan and agreeing on the actual amount of any loan. But for all loans, the applicant's repayment ability remains the overriding determinant of the limit of the loan. The income generated from the farm, together with any supplementary income, must provide an acceptable standard of living for the farm family and cover operating expenses and provide for debt repayment. The loan must also be suited to the purpose and needs of the borrower.

Borrowers are given up to 30 years to repay loans. But as farmers know, some years are leaner than others. FCC has always been flexible and sympathetic to the repayment problems faced by farmers. It often carries loans in arrears because of a variety of circumstances beyond the borrower's control. In some instances, FCC can limit repayment demands to interest only for the first 5 years or allow a borrower to make the first payment 24 months after the loan is made.

For a number of reasons, loans are also refused. If the applicant is not happy, he (she) can appeal the decision. Practical farmers of proven ability and judgement sit on the Appeal Board. They review the case and recommend whether a loan should be made.

Farm Syndicates Credit Act

This legislation provides financial means for farmers to cooperatively own machinery, buildings and installed equipment that they can share. Cooperative ownership can greatly reduce the cost of improved mechanization. In many cases, it means a farmer can take advantage of machinery that he (she) individually could not afford. These savings can often be put toward other investments for more efficient use of capital.

The Act defines a syndicate as a group of three or more farmers with the majority of them having farming as their principal occupation. FCC makes loans to syndicates to a maximum of $100,000 or $15,000 a farmer, whichever is less. In most cases, the loan is secured by a promissory note signed by the syndicate members. Terms for repayment cover up to 15 years for buildings and permanently installed equipment and up to 7 years for mobile machinery.

The Small Farm Development Program

This program consists of a Land Transfer Plan administered by FCC and a Rural Development and Farm Management Service developed with the cooperation of Agriculture Canada and the provinces.

The program helps owners of small farms to help themselves. Under the Land Transfer Plan, FCC makes special credit available to the small operator who wants to purchase land available under the program to develop a viable farm enterprise. It also helps those who wish to sell their land by providing a listing service for eligible vendors and paying an assistance grant for those who qualify.

Strength of the Corporation

In the administration of these programs, the strength of FCC rests on the ability of its 230 credit advisors. The credit advisor is the person who meets the farmer, analyzes the facts presented, and discusses the options available with each individual.

Once an application is formally made, the credit advisor visits the farm or farms and appraises the land, livestock and equipment. During these visits, an assessment is also made of the individual's management skills and potential in order to determine the borrower's repayment ability.

The credit advisor must be familiar with good farm management practices for a number of different enterprises and must have a good knowledge of agriculture in the area. The credit advisor must also be in tune with the ideas and philosophy of the community, and abreast of constant changes in land prices, market values and technology.

fondée sur le prix des terres dans la région en question.

Le prêt d'établissement graduel (Partie IV) La Loi sur le crédit agricole permet aux personnes de moins de 35 ans de s'établir graduellement en agriculture dans une période maximum de cinq ans. Celles-ci peuvent emprunter $150 000 au maximum pourvu que ce montant n'excède pas 100% de la valeur marchande des terres, des animaux et de l'outillage. Elles peuvent ainsi gagner un revenu à l'extérieur de la ferme pendant qu'elles aménagent une exploitation commerciale solide qui deviendra leur occupation dans les cinq ans suivant l'obtention du prêt.

Le requérant doit fournir un plan détaillé d'aménagement et d'exploitation de la ferme avant d'être jugé admissible. Il doit également démontrer comment le revenu de la ferme s'accroîtra au point de suffire à faire vivre sa famille. Pour ce faire, il doit avoir de l'expérience dans le type d'exploitation qu'il veut mettre sur pied. Il doit également démontrer, dans sa demande d'emprunt, qu'il a besoin d'une période de transition pour des raisons financières. En d'autres termes, cette voie n'est pas ouverte à ceux qui possèdent déjà les ressources voulues pour aménager une entreprise rentable au moment de la demande. La surveillance est obligatoire, ce qui permet à ces requérants d'avoir accès à des conseils judicieux au cours des premières années d'exploitation.

Autres facteurs

La Société analyse plusieurs autres facteurs avant d'approuver un prêt et d'en déterminer le montant exact. En pratique, c'est la capacité de remboursement du requérant qui détermine le montant maximal du prêt. De plus, le revenu de la ferme, ajouté à tout revenu supplémentaire, doit assurer un niveau de vie raisonnable à la famille agricole, couvrir les frais d'exploitation et suffire au remboursement de toutes les dettes. Le prêt doit également être adapté aux besoins de l'emprunteur et à ses objectifs.

Le terme maximum de remboursement est de trente ans. Cependant, la Société reconnaît qu'en agriculture il y a des années plus difficiles. C'est pourquoi elle se montre toujours souple et compréhensive envers les agriculteurs qui éprouvent des difficultés de remboursement et elle tolère souvent des comptes en arrérage pour diverses raisons qui échappent au contrôle de l'emprunteur. Dans certains cas, elle peut n'exiger que le remboursement des intérêts pendant les cinq premières années ou permettre à l'emprunteur de ne faire le premier paiement que 24 mois après l'octroi du prêt.

Lorsqu'elle refuse un prêt, le requérant peut en appeler de sa décision en s'adressant à la commission d'appel. Celle-ci est composée d'agriculteurs actifs reconnus pour leur compétence et leur jugement. Leur fonction est d'entendre les appels et de recommander de faire ou de ne pas faire un prêt.

Loi sur le crédit aux syndicats agricoles

L'objet de cette loi est de fournir aux agriculteurs le moyen de posséder en commun des machines, des bâtiments et de l'équipement fixe qui se prête à une utilisation en commun. L'achat collectif peut réduire fortement le coût de la mécanisation et permet souvent à un agriculteur de bénéficier de machines qu'il ne pourrait s'acheter seul. Ces épargnes permettent souvent d'autres investissements et conduisent à une utilisation plus rationnelle des capitaux.

Un syndicat doit comprendre au moins trois agriculteurs dont la majorité ont l'agriculture comme occupation principale. La Société peut leur consentir un prêt maximal de $100 000 ou de $15 000 par agriculteur membre, selon le moindre montant. La plupart des prêts sont garantis par un billet à ordre signé par les membres. Le terme de remboursement peut atteindre 15 ans dans le cas de bâtiments et d'outillage installé en permanence, et sept ans dans le cas de machines mobiles.

Le Programme de développement des petites fermes

Ce programme consiste en un plan de transfert des terres qui relève de la Société du crédit agricole et en un service d'aménagement rural et un service de gestion agricole qui ont été élaborés conjointement avec Agriculture Canada et les provinces.

Le but du programme est d'aider les propriétaires de petites fermes à s'aider eux-mêmes. En vertu du plan de transfert des terres, la Société offre un crédit spécial aux exploitants de petites fermes qui désirent acheter des terres devenues disponibles dans le cadre du programme, afin d'aménager une entreprise agricole plus rentable. La Société aide également ceux qui désirent vendre leur ferme en maintenant un service de catalogue à leur disposition et en versant un octroi aux vendeurs qui se qualifient.

Le point fort de la Société

Le point fort de la Société dans l'application de tous ces programmes réside dans la compétence de ses 230 conseillers en crédit. Le

Cooperative ownership through a farm syndicates' credit loan can reduce the cost of improved mechanization.

La propriété coopérative, par un prêt aux syndicats agricoles, d'une machinerie moderne permet des économies.

Training in farm management, appraisal practices and agriculture in general form part of this person's background.

Common sense and psychology are assets in determining the intent and sincerity of applicants. When a loan must be refused or altered, tact and diplomacy are handy attributes.

When a supervised loan is made, the credit advisor is responsible. The credit advisor must keep in touch with the farmer and his operation in order to offer counseling assistance if required.

The whole process of lending money is personal. It can only be handled on a one-to-one basis. It is too easy to describe an agency like FCC with dollar and cents values. That part of its function is essential, but the ultimate goal is to strengthen Canadian agriculture by helping individual farmers. ■

conseiller en crédit est celui qui rencontre l'agriculteur, qui analyse les fermes et qui discute des options disponibles avec chaque requérant.

Lorsqu'une demande en bonne et due forme a été faite, le conseiller en crédit se rend visiter la ou les fermes en question et évalue les terres, les animaux et l'outillage. Il détermine en même temps les capacités gestionnaires du requérant et sa capacité de remboursement.

Le conseiller en crédit doit connaître à fond les meilleures méthodes de gestion agricole pour les divers types d'exploitation et il doit bien connaître la région agricole où il est affecté. Il doit bien connaître les gens qu'il sert, leurs idées et leur mode de vie, et il doit se tenir au courant des changements dans le prix des terres, dans la valeur marchande et la technologie. Il lui faut connaître la gestion agricole, les techniques d'évaluation et l'agriculture en général.

Il doit faire preuve de bon sens et user de psychologie afin d'évaluer les intentions des requérants. Et lorsqu'il doit rejeter une demande d'emprunt ou la modifier, il doit faire preuve de tact et de diplomatie.

Lorsqu'un prêt surveillé est accordé, la responsabilité en revient au conseiller en crédit. Celui-ci doit rester en communication avec l'agriculteur et son exploitation afin de lui offrir des conseils utiles au besoin.

Tout le processus conduisant au prêt est de nature personnelle. Il ne serait en être autrement. Il est trop facile de décrire un organisme comme la Société du crédit agricole en termes de dollars et de gros sous. Cette partie de sa fonction est essentielle mais le but ultime de son travail demeure de renforcer l'agriculture canadienne en aidant les agriculteurs individuellement. ■

CANADA'S EUROPEAN CATTLE IMPORTATION PROGRAM

R. R. MILLER

Depuis 1965, 5 389 têtes de bovins représentant 22 races européennes ont été importées de six pays de l'Europe continentale pour mettre de nouvelles lignées à la disposition de l'élevage au Canada. Les nouvelles méthodes d'épreuve et l'établissement d'une station de quarantaine en France et de deux stations au Canada ont permis d'empêcher l'entrée de maladies animales.

The first cattle to enter this country were imported from Normandy and Brittany in France by Jacques Cartier in 1541. In those days, there was little concern about introducing animal disease. The prime interest was in establishing livestock in Canada.

A number of livestock have been imported from Great Britain during the past 50 years. Most have been of the traditional British breeds that have historically formed the nucleus of Canada's national herd.

For some time, the Canadian livestock industry has been interested in importing beef breeds from continental Europe to make new blood lines available that would improve the productivity and profitability of Canada's livestock industry. The problem with importing livestock from continental Europe has been the possibility of introducing serious livestock diseases into this country.

Because certain countries have eradicated some diseases and successfully controlled others, such as foot-and-mouth disease, through vaccination programs and the slaughter of infected herds, Canada took another look at importation of cattle from continental Europe. With new testing procedures available, and the establishment of quarantine stations in Europe and Canada, it was possible to prevent the introduction of diseases in imported cattle.

Dr. Miller is Associate Director, Import/Export, Contagious Diseases Division, Health of Animals Branch, CDA, Ottawa.

Maximum Security Quarantine

In 1965, a maximum security quarantine station was built on Grosse Ile to quarantine cattle from certain European countries. The first shipment of 105 Charolais cattle arrived from France at Grosse Ile in October 1965. The next year, facilities at Grosse Ile were doubled and 213 head were quarantined in the fall.

Canadian importers continued to show interest in European cattle. A second maximum security quarantine station was established in 1969, in cooperation with the French government, on the French island of St. Pierre. It had capacity for 240 animals, but this was increased to 360 in 1971. The two maximum security quarantine stations can handle 960 imported cattle a year.

Since 1965, 5,389 head, representing 22 European breeds, have been imported from six countries in continental Europe. It is anticipated that another country will be added during the next importation year. A third maximum security station on the French island of Miquelon, near St. Pierre, is presently being considered. This station could handle an additional 800 imports each year.

The two quarantine stations are operated and managed by Health of Animals veterinarians. The inspection and testing of cattle in Europe is conducted by or under the supervision of Branch veterinarians, including cattle under quarantine at the international quarantine station in Brest, and cattle in transit by boat to Canada.

European cattle undergo a 30-day quarantine in the Brest, France, quarantine station followed by a 90-day minimum quarantine at Grosse Ile or St. Pierre. After release from the Canadian quarantine station, the cattle go directly to the importer's premises where they undergo a further quarantine of 90 days. During this time, they are placed in contact with native Canadian cattle. They are then released from quarantine restrictions and become part of the national herd.

Transportation of cattle by boat from Europe is supervised by Health of Animals Branch staff.

Cattle are unloaded at Grosse Ile for a minimum quarantine period of 90 days.

The St. Pierre quarantine station off the coast of Newfoundland can house 360 head of cattle.

Minimum Security Quarantine

Cattle imported from Great Britain are quarantined for 14 days in that country followed by a 30-day quarantine at minimum security stations at Levis, Quebec, or Edmonton, Alberta.

Great Britain has also imported a number of the continental European breeds in recent years. In addition to native British breeds, the progeny of the continental European breeds, that are born and raised in Great Britain, are eligible for importation to Canada. This has been an additional source of exotic breeds for Canadian importers. For the past three years, all of the cattle transported from Britain have come by chartered aircraft. A third minimum security quarantine station is scheduled for completion in the summer of 1976 at Mirabel International Airport north of Montreal.

Permit Allocation

As the result of the keen interest in importing cattle from continental Europe, a system of permit allocation was developed by Agriculture Canada. For example, for the 1975-76 importation year, a total of 3,400 requests for permits to import 10,000 head of cattle were received. Each applicant must provide a written project proposal outlining present cattle inventory and the proposed breeding program, particularly for the European breed which the applicant wishes to import. In addition, an Agriculture Canada officer interviews each applicant about his project proposal and views his facilities. The project proposal and farm visit report are then submitted to an Advisory Genetic Review Committee, composed of four scientists associated with livestock production. Two members are Agriculture Canada employees and two are from universities. The committee review of project proposals and farm visit reports is conducted without knowledge of the applicant's name. Each application is rated by the committee on the basis of the information contained in the project proposal and farm visit report. Permits for importing cattle from Europe are then allocated on this basis.

Ten years' experience has shown that importing livestock from countries not traditionally free of serious livestock diseases can be effective without jeopardizing the favorable animal disease situation in Canada. ■

CONTROLLING BLACK FLY OUTBREAKS

F. J. H. FREDEEN

D'importantes manifestations de mouches noires, *Simulium arcticum*, menacent depuis des dizaines d'années la santé des animaux domestiques le long des rivières Saskatchewan et Athabaska. Malgré l'efficacité du DDT contre les mouches noires, on a retenu, en 1968, le méthoxychlore comme moyen plus sûr de lutte chimique. Une simple injection de 0,3 ppm de méthoxychlore, pendant 15 minutes, peut détruire les deux tiers des larves des mouches noires jusqu'à 100 milles en aval.

Sporadic but severe outbreaks of the black fly, *Simulium arcticum*, have killed or threatened the health of domestic animals since the earliest days of agricultural settlement. Swarms carried by favorable winds have killed cattle as far as 140 miles from breeding places in the largest mountain-fed rivers in Saskatchewan and Alberta. Entomologists from the Saskatoon Research Station have recently improved an abatement scheme originally developed by this station about 25 years ago.

S. arcticum differs in several ways from the other 100 or more species of black flies distributed across Canada. It attacks animals rather than man. Its salivary secretions, injected while extracting a blood meal, are relatively powerful. Non-immune animals such as newborn calves and imported bulls react quickly and violently to its bites. Immense numbers of black flies are produced in some outbreaks. It is uniquely adapted in several ways to breeding in the largest mountain-fed rivers on the western prairies. Related but less virulent species, such as *S. venustum*, breed in the smaller rivers across Canada, but most species, which are generally innocuous, breed only in the smallest streams. Living conditions in the Saskatchewan and Athabasca Rivers, however, are too difficult for the larvae of most species of black flies except those of *S. arcticum*. The river beds and shorelines, which are bare of vegetation, are composed of shifting quicksands interspersed with rock-filled rapids. The water is often very muddy, and the river volumes fluctuate daily and often violently according to the snow melt and precipitation rates in the large watersheds.

Cow lying down to protect itself during an attack by *Simulium arcticum*.

Instead of attaching its eggs in masses to the wet surfaces of boulders like other black flies, it bombs the river with its eggs. The eggs settle to the river bed where they are protected from drying and freezing until the ice breaks up the following spring. As many as 570 eggs have been extracted from a single cubic foot of sand dredged from the bed of the Saskatchewan River.

After hatching in late April or early May, the larvae drift with the river currents downstream to rapids. There the larvae attach themselves to clean boulders to complete their development and pupate within 4 to 6 weeks.

These rock-filled rapids are capable of supporting large numbers of larvae. As many as 450 larvae and pupae per square inch of rock surface were counted in May 1947. About 2 weeks later swarms of bloodthirsty black flies commenced to emerge from these and numerous other rapids in the north and south branches of the Saskatchewan River. They were carried by favorable

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Areas of Saskatchewan and Alberta occasionally subjected to outbreaks of *Simulium arcticum black flies.*

winds into wide areas of Saskatchewan where they killed over 200 animals.

This was the last of the great black fly outbreaks from the Saskatchewan River. In 1948, tests began with a DDT larvicide that had earlier shown promise. Tests in the Saskatchewan River in subsequent years showed that a single 15-minute application of only 0.1 to 0.3 parts of DDT per million parts of water could eliminate sufficient black fly larvae to prevent outbreaks from a 100-mile or longer section of the Saskatchewan River.

The amounts of DDT used over the years were small, adding less than 1 percent to the estimated "background load" of DDT from global sources normally carried in the river water. In 1968, DDT and metabolite residue levels in fish in the occasionally treated portion of the river below the Gardiner Dam were as low as those above the dam, i.e. in fish that had never been exposed to these larvicide treatments.

In 1968, field tests were recommenced with the cooperation of the Saskatchewan Departments of Agriculture and Environment to find an "ecologically soft" chemical to replace DDT as a black fly larvicide. Several chemicals were tested, but from the outset methoxychlor looked promising although it too was a chlorinated hydrocarbon. Unlike DDT, it is water soluble in the diluted concentrations required to affect the larvae. Also, unlike DDT, methoxychlor is readily broken down into simpler water soluble molecules that are readily eliminated by fish or warm-blooded animals. Thus, vertebrates do not accumulate methoxychlor residues like they did DDT, nor do the residues become magnified in food chains. These characteristics overcame the worst objections of DDT.

Methoxychlor Effective

Methoxychlor is similar to DDT in one important aspect. Residue analyses showed that methoxychlor applied to the river was quickly adsorbed by the silt and clay particles carried in the water. This greatly enhances the value of methoxychlor as a black fly larvicide because the larvae are indiscriminate filter feeders that normally filter out and ingest large quantities of these silt and clay particles from the water. No other species of insect larvae inhabiting the Saskatchewan River are exclusively filter feeders capable of filtering out such minute particles. Theoretically, methoxychlor applied to the turbid water can act selectively against black fly larvae.

Adsorption of the methoxychlor onto these suspended particles may also help to explain why a single treatment is effective for long distances. In tests, the effects of a single injection were studied in a 100-mile (161 km) section of the North Saskatchewan River. Ninety-six percent of the younger black-fly larvae and 66 percent of the more mature larvae were removed from the "100-mile" site. All larvae were removed from the "25" and "50-mile" sites and 91 percent of the more mature larvae from the "75-mile" site. Plecoptera (non-target) larvae were similarly affected but all other non-target orders were much

less affected. Chironomidae larvae in the river bed sand, comprising a major portion of the arthropod biomass of the river, apparently were not affected by this treatment.

The treated portion of the river was rapidly repopulated. The population densities of all taxa quickly returned to normal and many new taxa appeared (as is normal for this time of the year) during the 10-week period immediately following the treatment. In all four sites sampled at weekly intervals 25 to 100 miles downstream from the injection point, population densities of larvae larger than 1 mm long equalled or surpassed the pretreatment densities as follows: Ephemeroptera within 1 to 4 weeks, Trichoptera 1 to 7 weeks, and Plecoptera within 4 to 5 weeks. Populations of larvae smaller than 1 mm long were generally restored more rapidly. These new populations consisted of larvae that had escaped the effects of the methoxychlor (larvae temporarily affected often recover), larvae that drifted downstream from the untreated portion of the river, and larvae that hatched after the treatment.

In summary, these tests showed that a single 15-minute injection of 0.3 ppm of methoxychlor may be expected to remove more than two-thirds of the black-fly larvae from rapids in the Saskatchewan River as far as 100 miles downstream from the point of injection. However, results have varied between tests for reasons not yet understood. Water temperature, water turbidity and river volume are continually fluctuating, and are believed to affect treatments. It remains to be seen how methoxychlor affects *S. arcticum* larvae and non-target organisms in the Athabasca River, another source of severe black-fly outbreaks.

Our present research includes developing a monitoring system to provide estimates each year for the necessity, timing and location of black-fly larvicide treatments. To do this, artificial substrates will be anchored in the river each spring after the ice leaves the river. The numbers of *S. arcticum* larvae attached to these substrates will hopefully provide the means for comparing population densities from year to year. ■

Larvae of *Simulium arcticum* attached to a plastic plate that had been anchored in the Saskatchewan River for 10 days.

PASTURE MANAGEMENT— KEY TO EFFICIENT DAIRY INDUSTRY

L. J. FISHER

Le coût de production des fermes laitières augmente parce que ces dernières dépendent de plus en plus des sources d'aliments qui viennent de l'extérieur. L'exploitation efficace des pâturages peut stabiliser ou réduire le coût des aliments puisque les pâturages répondent en grande partie aux besoins nutritifs du troupeau laitier.

The costs of producing milk have increased sharply in the last 3 years. Prices paid to farmers have increased to enable them to make enough money to stay in business. As a result, the price of milk to consumers has risen to the point where they may use less milk. If less milk is sold, or competing substitutes take over a significant portion of the market, the dairy industry may again be faced with surpluses.

The dramatic increase in input costs to the dairy farm has been partially due to inflation. However, most of the increase can be attributed to the growing dependency of the industry on off-farm sources for feed, primarily grain and protein supplements, and, in extreme cases, forage supplies as well. The cost of inputs for these enterprises, therefore, is sensitive to any increases in cost of labor, energy, and transportation and to shortages of feed. For world food supply and energy conservation, it is unrealistic for this trend to continue. To maintain the price of milk at a level where it will not be a luxury item for lower income families, it is essential that dairy farms become more self- sufficient.

Productive pasture is an effective means of stabilizing feed costs. Pastures contribute greatly to the total nutrient requirements of a dairy herd. Inputs necessary for optimum production vary markedly depending on local conditions. There are, however, several principles that may be used as guidelines in establishing and using pastures.

Pasture Management

Land selected for pasture should be located within a ½ mile of the milking parlor. It should be reasonably fertile, adequately drained, free of major weed problems, and have clean water and shade. The area required depends on climatic conditions and availability of irrigation, but a milking herd of 40 cows would need about 40 ac subdivided into 5 ac plots for a rotational grazing system.

Great care should be exercised in the selection of species and varieties of legumes and grasses compatible with specific environmental conditions. Once established, proper grazing and fertilizer management must be employed to maintain selected forage species, particularly legumes. Accurate application of fertilizer depends on routine soil testing. Nitrogen may be required for optimum grass production, particularly in offsetting mid-summer dormancy, while potassium will maintain legume population. However, excess potassium can inhibit uptake of magnesium by plants causing magnesium deficient herbage.

Developed pastures should be grazed when they are 8-10 in. high and cows removed from the pasture when the average forage height is approximately 2-3 in. After grazing, clipping will assist in weed control and maintenance of forage quality. Harrowing will distribute manure and contribute to more uniform growth and grazing.

Rotational grazing systems may be modified by subdividing the herd so that high producing cows graze first and cows in late lactation or dry cows and heifers graze the aftermath.

To consistently obtain a competitive nutrient yield from pasture, it is imperative that constant attention be given to the small details of proper pasture management. ■

Dr. Fisher is a dairy nutritionist at the CDA Research Station, Agassiz, B.C.

WEED SEEDS IN DOCKAGE IN MANITOBA

PAUL N. P. CHOW and
W. J. LAPKA

Les chercheurs de la Station de recherche de Brandon ont fait une étude sur les graines de mauvaises herbes contenues dans le blé, l'orge, le lin et le colza et ont découvert qu'il y avait moins de déchets dans les céréales (3%) que dans les oléagineux (9.7%). Les céréales non nettoyées contenaient un grand nombre de graines de mauvaises herbes, soit une moyenne de 18 359 graines par kilogramme (8 327 graines/lb) pour les quatre cultures. L'écart observé dans les pourcentages de déchets révèle qu'on peut obtenir des céréales propres avec l'emploi d'herbicides, une bonne préparation du sol et un choix judicieux du moment opportun pour les diverses activités de plein champ.

Dockage, including broken grains, weed seeds, chaff, dirt, and other foreign materials, is a serious problem in grain. It not only affects the quality of grain, but also contributes to transportation costs and cleaning costs at terminal elevators. In 1972, Shuttleworth[1] reported that in the last 5-year period dockage at primary elevators averaged over 2.5 percent for cereals and 9 percent for oilseeds. However, there is no information available on the proportion of dockage due to weeds. In 1974, we conducted a survey on the amount and type of weed seeds in grain samples of wheat, barley, flax, and rapeseed in Manitoba.

Dr. Chow is a weed research scientist at CDA Research Station, Brandon, Man. W. J. Lapka is a weed specialist, Manitoba Department of Agriculture, Brandon, Man. The authors thank the 28 weed supervisors for collecting grain samples.

[1] Shuttleworth, C. T. 1972. Needed: a program for elimination of the wild oat problem. Minutes 26th Ann. Meet., Can. Weed Comm. (W. Sect.), Winnipeg, Man.

Sampling

In the fall of 1974, 28 municipal weed supervisors in Manitoba each collected at random six 500-gm (17.8 oz) samples of wheat, barley, flax, and rapeseed from farmers or elevators. The weed supervisor areas are grouped into five regions according to where samples were collected (Figure 1). The sampling did not take into consideration such factors as cultural practices and herbicides used. At the Brandon Research Station, each sample was separated into its various components and each component was weighed. The percentage of each component is expressed on the basis of air-dried weight.

Results

Apparently there was less dockage in cereals (3 percent) than in oilseeds (9.7 percent) (Table 1) probably because during the early growth stage cereals are more strongly competitive with weeds than oilseed crops. The average dockage in this survey was slightly higher than reported by Shuttleworth. One reason may be the restrained use of herbicides because of wet weather in the early spring of 1974. The wide range in percentage dockage indicates that clean

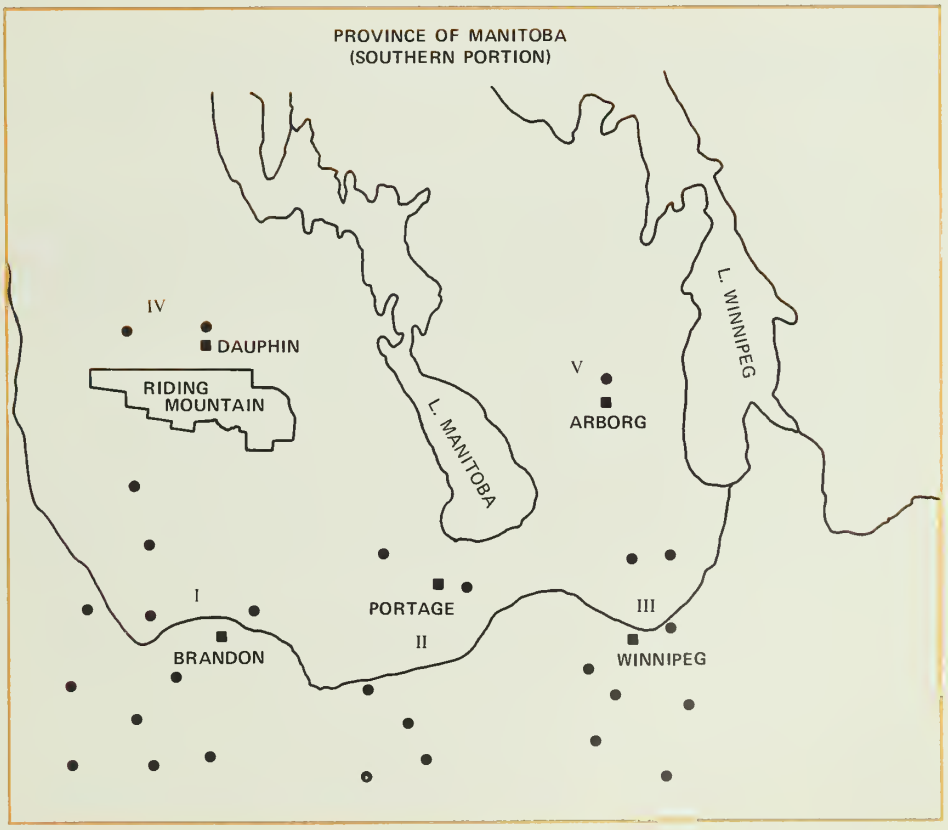

Figure 1 Areas of Manitoba where unclean grain samples were collected.

grain can be obtained with herbicides, good soil preparation, and timeliness of field operations.

Roughage (dockage from broken seeds, chaff, and dirt) is a serious problem, especially in flax and rapeseed with 6.7 percent and 4 percent, respectively, compared with wheat and barley with 0.5 percent and 1.2 percent (Table 2). Volunteer crops also represent a problem and can seriously affect crop yields, particularly flax and rapeseed (Table 2). Wild oats and green foxtail were two main weed seeds found in the four crops. Barley contained more seeds of wild oats and green foxtail than wheat, despite the fact that barley generally is more competitive with weeds than wheat. Probably two factors are involved. First, wheat generally is seeded on summerfallow more frequently than barley. Because of frequent cultivation summerfallow land usually is more free of weeds. Second, farmers may apply less herbicide for weed control on barley since it is a better competitor with weeds. Fewer seeds of broadleaf weeds (lambsquarters, pigweed, mustard, and buckwheat) were found in cereals than in oilseeds. This may be directly related to the extensive use of herbicides such as 2, 4-D, MCPA, etc. in cereal crops. Wild oats are a serious problem in the cooler northern areas (Region IV and V) while green foxtail is more serious in Region I and II (Table 3). Within the southern regions, dockage from wild oats was greater in Region I than in Region II and III. The explanation for this is not clear and more data are needed for clarification.

Uncleaned grain contained large numbers of weed seeds ranging from 7174 seeds/kg (3254 seeds/lb) in wheat to 33556/kg (15221 seeds/lb) in rapeseed with an average of 18359 weed seeds/kg (8327 seeds/lb) for the four crops examined (Table 4). The high number of weed seeds reveals the degree of weed infestation and resulting loss of grain production. This suggests that all possible methods should be used to combat weeds and maintain a high level of efficient food production. ■

TABLE 1 DOCKAGE IN 1974 UNCLEANED GRAIN SAMPLES IN MANITOBA

Grain	% dockage on wt basis		No. of samples examined
	Av	Range	
Cereal	3.0		
Wheat	2.2	0.6- 5.9	178
Barley	3.9	0.8- 9.5	167
Oilseed	9.7		
Flax	11.6	5.4-21.7	171
Rapeseed	7.8	2.2-16.2	144

TABLE 2 COMPOSITION OF DOCKAGE IN UNCLEANED GRAIN (% ON WEIGHT BASIS)

Grain	Roughage[1]	Volunteer crop grain	Weed seeds						
			Wild oats	Green foxtail	Lambs-quarters	Pig-weed	Must-ard	Buck-wheat	Total
Wheat	0.54	0.12	0.47	0.83	0.07	0.08	0.04	0.07	1.56
Barley	1.19	0.01	1.19	1.29	0.08	0.04	0.04	0.09	2.73
Flax	6.69	1.89	0.92	1.13	0.11	0.50	0.23	0.16	3.05
Rapeseed	3.96	0.88	0.84	0.53	0.17	1.32	0.03	0.08	2.98
Average	3.10	0.98	0.86	0.95	0.11	0.49	0.09	0.10	2.56

[1] Roughage includes broken seeds, chaff, and dirt.

TABLE 3 PERCENTAGE OF SEEDS OF WILD OATS AND GREEN FOXTAIL IN UNCLEANED GRAIN IN DIFFERENT REGIONS[1] IN MANITOBA

Grain	Region	Wild oats					Green foxtail				
		I	II	III	IV	V	I	II	III	IV	V
Wheat		0.61	0.35	0.20	0.94	0.87	1.25	1.27	0.21	0.12	0.00
Barley		1.09	1.09	0.67	1.86	4.83	1.91	2.01	0.32	0.23	0.00
Flax		1.18	0.74	0.44	2.10	0.58	2.12	0.91	0.31	0.11	0.04
Rapeseed		1.28	0.64	0.44	0.04	1.20	1.05	0.42	0.03	0.00	0.00
Average		1.04	0.71	0.44	1.23	1.87	1.58	1.15	0.22	0.12	0.01

[1] No. of areas where samples were collected in different regions are in Figure 1: 11 in Region I, 6 in Region II, 8 in Region III, 2 in Region IV, and 1 in Region V.

TABLE 4 NUMBER OF WEED SEEDS PER KILOGRAM OF UNCLEANED GRAIN

Grain	Wild oats	Green foxtail	Lambs-quarters	Pig weed	Must-ard	Buck-wheat	Total
Wheat	260	6,640	100	160	2	12	7,174
Barley	670	10,320	110	80	2	15	11,197
Flax	520	9,040	1,570	10,000	106	274	21,510
Rapeseed	470	4,240	2,430	26,400	2	14	33,556
Average	480	7,560	1,052	9,160	28	79	18,359

THE DIETS OF CATTLE AND DEER ON RANGELAND

W. WILLMS, A. McLEAN, R. RITCEY and D. J. LOW

Le gibier concurrence le bétail dans les parcours, posant l'un des principaux problèmes d'intégration des ressources fourragères de ces terres. L'observation des variations des régimes alimentaires saisonniers des bovins et des cerfs a permis aux chercheurs de la Station de recherches de Kamloops de constater que la concurrence pour les mêmes plantes était minimale en parcours d'hiver, lorsque la paissance des bovins était maintenue aux niveaux recommandés. Grâce à un taux de charge modéré et une bonne gestion des parcours, les bovins et les cerfs pourraient profiter de l'utilisation commune des parcours d'hiver.

Big game animals compete with livestock in many areas, creating problems integrating the use of forage resources on rangelands. Critical game ranges should be given preference over most other land uses because game habitats and habits cannot be easily changed. Big game production on a sustained basis, in many cases, can be exploited by understanding habitat manipulation. Livestock management practices, such as control of livestock distribution and time of use, should be considered to achieve forage improvement on depleted areas and integrating of uses. Such practices can lead to increased forage production and an increase of preferred species by the removal of competing plants.

Information on the seasonal diet changes of cattle and deer is basic to making game-vs-cattle management plans. Such observations should tell us when cattle use important deer forage species. It is also important to determine whether or not grazing by cattle affects subsequent use by deer.

To evaluate this problem on Kamloops ranges, Agriculture Canada, together with the B.C. Fish and Wildlife Branch, and B.C. Forest Service, undertook a project designed to study the seasonal diets and distribution of both deer and cattle.

Range Study Area

The deer winter range study area is located on the north side of Kamloops Lake about 24 km (15 miles) west of Kamloops. About 4 sq km (1½ sq miles) were fenced to include both grassland and open forest. The area is characterized by a steep, southern slope, extending from the lake to an open forest about 1.6 km (1 mile) away.

At present, big sage dominates the plant cover on the open range, along with either bluebunch wheatgrass or needle-and-thread. In some areas, particularly knolls and steep slopes, rabbitbrush or pasture sage is abundant. Sandbergs bluegrass is common and may become dominant on shallow soils. In the upper part of the study site, ponderosa pine — bluebunch wheatgrass savannah predominates. The most common shrub is rabbitbrush.

The area is valuable as late fall — early spring cattle range and winter range for deer. Snowfall is light and the direct southern exposure promotes early growth and a warm environment.

Grazing permits were issued in 1947 and revoked in 1965 when

The cattle-deer winter range research area near Kamloops.

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overgrazing forced cancellation of the permits. The B.C. Forest Service rehabilitated the area by resting and seeding about 81 ha (200 ac) to crested wheatgrass in late 1964. Cattle have not used the range since, and recovery of native grasses is encouraging, but not complete.

The most abundant large wild mammal is deer. Winter densities average 8 to 12/sq km (20 to 30/sq mile) with more in the spring. The mule deer herd depends on the area for winter and spring range, migrating from at least 80.5 km (50 miles) north.

Studies in Progress

Cattle were grazed on the range in both the spring and fall at stocking rates that left ample grass at the end of the study period. Two rumen fistulated beef cows were used in each grazing trial to provide rumen samples for the study of cattle diets, supplemented by direct observations.

Deer diets were studied from rumen samples of primarily hunter-killed deer. This was supplemented by direct observations of tame deer and following trails of free-ranging deer. Some rumen samples were from outside the study area, but represent diets of migratory deer similar to those in the area.

Diet is related to the relative abundance of each forage and animal preference. Spring diets were determined from early April to mid-May and fall diets from early November to mid-December (Table 1). Grass dominated the diet of cattle except in the fall when snow forced the cattle into the open forest or onto southern slopes blown clear of snow. This shift increases the proportion of grass and shrubs eaten, and decreases the use of forbs and trees.

Rumen fistulated cows were used to provide samples of cattle diets.

Most deer moved onto their winter range after mid-December and left in early May. The extent that the deer use the winter range seems to be dependent on weather conditions. Deep snows on the upper slopes (fall range) force the deer down onto the winter range. However, if these conditions are not present, the green grass in the spring brings them down.

TABLE 1 PROPORTION OF FORAGE CLASSES PRESENT IN THE RUMENS OF COWS ON SPRING AND FALL RANGES (PERCENT BY WEIGHT)

	Spring		Fall	
Forage	1973	1974	1972	1973
	%	%	%	%
Grasses	96.4	93.5	93.6	88.4
Forbs	0.7	0.5	3.0	2.2
Shrubs	0.7	1.5	1.2	2.2
Trees	2.2	4.5	2.2	7.2

TABLE 2 PROPORTION OF FORAGE CLASSES PRESENT IN THE RUMENS OF DEER WITHIN FIVE PERIODS FROM SEPT. 15 TO APRIL 30

Forage	Sept. 15 Oct. 31	Nov. 1 Nov. 30	Dec. 1 Dec. 31	Jan. 1 Mar. 15	Mar. 16 Apr. 30
Grasses	1.6	2.7	.2	3.1	64.0
Forbs	15.1	22.7	11.9	2.2	0
Shrubs	47.6	36.6	15.2	45.4	10.9
Trees	3.3	22.0	62.9	32.9	17.5
Other	6.9	3.0	.2	.6	.2

The deer's diet varied considerably (Table 2). With increasing snow depth in mid-winter, douglas-fir was the main species eaten. Deer seldom used the open range in mid-winter. In early spring, deer sought the first available green grass. Since both snow melt and plant growth occur first on the steep, southern slopes, the deer feed on these slopes.

In the spring, deer eat mainly Sandbergs bluegrass, and later bluebunch wheatgrass. Junegrass is also readily eaten when available. Sandbergs bluegrass is immediately available to deer when the snow melts to expose fall regrowth and when it sprouts new shoots in the spring. This grass loses its appeal to deer earlier than bluebunch wheatgrass because Sandbergs bluegrass matures more rapidly. Spring growth of bluebunch wheatgrass may occur as soon as Sandbergs bluegrass. But until the new stalks of the former extend beyond the old stubble, they are essentially not available to deer. Consequently, where the mature stalks have been grazed by cattle the previous fall or winter, the new growth is available much sooner. This characteristic and the fact that bluebunch wheatgrass remains green longer than Sandbergs bluegrass make it an important forage in the management of deer and cattle range.

Competition for consumption of the same plants was minimal on the winter range when cattle grazing was kept at recommended levels. But it became evident when areas were overgrazed or when increasing snow depth forced cattle to browse extensively. Competition is greatest in late winter and early spring when deer depend largely on new grass or previous fall regrowth to replace lost body weight and provide nourishment for fetal growth. Cattle grazed too early in the spring provide direct competition for feed. It is this period when fall and spring grazing practices can either adversely or positively affect the deer's diet and nutritional status. However, fall grazing by cattle removes mature stalks of bluebunch wheatgrass, making new grass more accessible to deer in the spring and permitting them to feed on high-quality forage.

Research is continuing on this project. However, we feel that joint use of the dry, winter range near Kamloops by cattle and mule deer is mutually beneficial under moderate stocking rates and good range management. ■

The mule deer depend on the area for winter and spring range.

LUTTE INTÉGRÉE CONTRE LES ACARIENS PHYTOPHAGES

B. PARENT

Integrated control of apple orchard mites is possible with the use of minimum applications of selective pesticides. Natural enemies effectuating biological control of apple mites, especially the European red mite, are among the Arachnidae, the Phytoseiidae, the Thripidae, the Coccinellidae and some Pentatomidae.

Les acariens nuisibles aux pommeraies du Québec sont: le tétranyque rouge, le tétranyque à deux points, l'ériophyide du pommier et le phytopte du poirier. Le plus important par ses dommages est le tétranyque rouge. Aussi le présent article fait-il référence surtout à celui-là.

La répression chimique a fait l'objet de recherches à court terme durant plusieurs années, sans doute parce que les besoins étaient pressants et que les pomiculteurs voulaient des solutions rapides à leurs problèmes.

Depuis quelques années cependant, la recherche agronomique tente de combiner la lutte biologique à la lutte chimique pour la protection des cultures fruitières. La réalisation de cet objectif diminuerait les coûts de production tout en éloignant les dangers de pollution par les pesticides. Toutefois la mise en application de cette méthode comporte de nombreux paramètres et de multiples facteurs. Pour une espèce particulière, e.g. le tétranyque rouge, des résultats valables sont réalisables à condition de préserver les ennemis naturels. La lutte intégrée suppose, quand même, la tolérance de quelques dommages par les insectes.

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Le but de cet article est de démontrer que les acariens, particulièrement le tétranyque rouge, peuvent être tenus en échec par leurs ennemis naturels à condition d'employer un minimum de pesticides.

Parcelles expérimentales

Dans un verger de quelque 500 pommiers (9 acres environ), de variétés McIntosh, Lawfam et Cortland, les pesticides suivants (Tableau 1) furent appliqués contre la tavelure et les principaux insectes.

Le fongicide captane a été employé chaque année parce qu'il ne nuisait pas aux acariens. Sur une période de 7 ans, deux fois seulement fut-il nécessaire d'appliquer un acaricide (dicofol), i.e. en 1962 et 1963.

Tétranyque rouge, femelle.

Lutte biologique

Les ennemis naturels qui faisaient la lutte aux acariens dans les parcelles d'observations appartenaient aux arachnides, aux phytoseiides, aux coccinelles, aux pentatomides et aux thrips.

Les arachnides sont les plus importants prédateurs s'attaquant aux tétranyques rouges parce qu'ils passent tout l'été dans le verger, particulièrement les espèces *Metaphidippus protervus* (Walkenaer), *Misumena vatia* (Clerck) et *Paraphidippus marginatus* (Walkenaer).

Les phytoseiides sont encore plus utiles parce qu'ils se nourrissent exclusivement d'acariens et qu'ils font leur cycle évolutif entièrement sur les pommiers. Les espèces *Zetzellia mali* (Ewing) et *Typhlodromus rhenanus* (Oudms) étaient plus nombreuses que les autres et par conséquent plus efficaces.

Les thrips les plus nombreux étaient les espèces suivantes: *Haplothrips faurei* (Hood) et *Leptothrips mali* (Fitch), qui étaient considérés aussi utiles que les phytoseiides.

Les coccinelles, particulièrement *Cycloneda sanguinea* L. et *Stethorus punctum* Lec., faisaient une lutte efficace aux acariens.

Quant aux pentatomides, elles apportaient leur contribution à l'occasion, vu qu'elles n'ont pas de préférence particulière.

Lutte intégrée

La lutte biologique se maintient dans les vergers quand elle repose sur un équilibre biologique, i.e., quand les ennemis naturels ont suffisamment de nourriture. Mais parfois il y a des fluctuations qui font que la proie augmente au détriment du prédateur, ce qui peut amener des dommages plus abondants que prévus aux récoltes. Dans un cas pareil,

Typhlodromus rhenanus (Oudms) acarien prédateur.

TABLEAU 1 PESTICIDES APPLIQUES ET LE NOMBRE DE TRAITEMENTS DANS LE VERGER EXPERIMENTAL 1900-1970

	1960	1961	1962	1963	1965	1966	1967	1968	1969	1970
FONGICIDES										
captane	10	11	10	10	9	14	14	5	10	6
glyodine	—	—	—	—	3	—	—	—	—	—
dichlone	—	—	—	—	—	—	1	—	1	4
dodine	—	—	—	—	—	—	—	12	6	4
INSECTICIDES										
carbaryle	2	—	—	—	2	—	1	2	3	—
ars. pb	1	2	5	1	1	2	3	2	2	3
sulf. nic.	—	1	—	1	—	—	—	—	—	—
dicofol	—	—	1	1	—	—	—	—	—	—
methoxychlore	—	—	—	1	—	—	—	—	—	—
methidathion	—	—	—	—	—	—	—	—	—	1
phosalone	—	—	—	—	—	—	—	—	—	1

la lutte biologique est insuffisante à régler le problème. Or il faut compenser par l'emploi minimum de pesticides sélectifs, ce que nous appelons une lutte intégrée.

Combiner la lutte biologique à la lutte chimique est une chose relativement facile quand il s'agit d'une espèce en particulier, mais la complication vient de la combinaison du contrôle de plusieurs espèces nuisibles. Or on a observé durant plusieurs années qu'il n'y a pas plus que deux ou trois ravageurs vraiment nuisibles dans un même verger, et qu'en n'utilisant que les produits absolument nécessaires et peu toxiques aux prédateurs, on assurait une protection à meilleur compte, et l'on protégeait en même temps la faune utile. C'était, en fait, un programme rationnel de l'emploi des pesticides.

Or avec le programme de traitements ci-haut mentionné, on n'a pas eu plus de dommages par les insectes que ce qui paraît dans le Tableau 2. Les dommages se rapportent surtout aux insectes contre lesquels il n'y a pas eu de traitements. Est-ce que les dépenses occasionnées pour traiter ces insectes auraient été inférieures aux pertes dues à ceux-là? Pour notre part, nous croyons qu'en raison du prix actuel des pesticides

TABLEAU 2 POURCENTAGE DE DOMMAGES PAR LES INSECTES DANS LES PARCELLES EXPERIMENTALES

Insectes	1961	1962	1963	1965	1966	1967	1968	1969	1970
Pyrale de la pomme	0,05	0,05	0,10	—	—	—	—	—	—
Tordeuse du pommier	3,65	1,75	0,50	2,50	3,00	1,55	—	—	—
Puceron rose	2,70	0,15	0,70	—	—	—	—	—	—
Ver du fruit vert	2,00	0,45	0,25	—	—	0,25	—	—	0,35
Charançon de la prune	0,20	0,30	0,30	0,05	—	—	—	0,10	—
Punaise terne	0,15	2,65	—	1,00	0,50	0,75	—	—	1,70
Pique-bouton	—	0,05	—	—	—	—	—	—	—
Punaises	—	—	1,55	—	—	—	2,10	0,85	—
Tordeuses	—	—	—	—	—	—	2,10	0,50	4,30

les traitements auraient été plus dispendieux que les pertes encourues par les insectes, du moins pour les insectes qui n'ont pas causé plus que 1% de dommage.

Il faut admettre cependant qu'il aurait été avantageux parfois de faire un traitement supplémentaire. Par exemple, en 1961, un insecticide aurait pu réprimer en même temps la tordeuse du pommier, le puceron rose et le ver du fruit vert; en 1962, la tordeuse du pommier et la punaise terne; les autres années aussi, un seul traitement supplémentaire aurait été justifié contre les tordeuses et les punaises.

On peut donc affirmer que la lutte intégrée est réalisable en utilisant les pesticides d'une façon rationnelle. D'une part les prédateurs font une lutte biologique efficace pourvu qu'on leur laisse la vie; d'autre part, les pesticides sont utiles pourvu qu'on choisisse ceux qui sont sélectifs et efficaces. Il ne faut pas oublier que l'emploi rationnel des pesticides constitue la base de la lutte intégrée. ■

WEED CONTROL WITH PLANT PATHOGENS AND NEMATODES

A. K. WATSON and
P. HARRIS

Les agents pathogènes des plantes et les nématodes apportent de nouvelles possibilités au désherbage biologique. Les chercheurs de la station de recherches de Régina étudient les effets des nématodes sur la centaurée de Russie. La folle avoine pourrait également être combattue avec succès si les chercheurs réussissaient à trouver un organisme pathogène à hôte spécifique qui n'attaquerait pas les autres plantes d'importance économique.

Biological control of weeds is the use of natural enemies to reduce the density of a weed. Insects have been most frequently employed and one of the current limitations of the method is the scarcity of insects that will damage the weed and not attack related crop plants. However recent results indicate that plant pathogens may extend the application of biological control to weeds, such as wild oats, for which suitable insects are not available. Plant pathogens offer two advantages over insects as biological control agents: 1) they are often more host specific; and 2) they can be applied with conventional spray equipment when the weed is at its most susceptible stage. Pathogens have the potential to produce major reductions in plant populations as has happened with Dutch elm disease, late blight of potato and white pine blister rust.

Biological control has conventionally been applied against alien species of weeds by introducing one or more of its natural enemies. A dramatically successful control of a weed with a pathogen used in this manner has been achieved against skeleton weed, the major weed of wheat in southern Australia. A strain of the rust, *Puccinia chondrillinia*, from a small region in Italy was found to be highly virulent on the main genotype of skeleton weed involved. This strain, that attacks all aerial portions of the weed, was established in Australia in 1971. It spread rapidly by wind and presently controls the weed over most of its range with such success that some farmers have ceased using herbicides on wheat.

The success of the *Chondrilla* rust in Australia can be partly attributed to the genetic uniformity of the skeleton weed. This occurs because reproduction is entirely apomictic[1]. In Canada, introduced apomictic weeds such as narrow-leaved hawk's-beard and orange hawkweed are obvious targets for biological control with introduced pathogens.

Introduced weeds from a few restricted sources are likely to lack the full range of disease resistance that occurs in the native habitat. On this basis, weeds such as diffuse knapweed and Eurasian watermilfoil are good targets for pathogenic weed control. Host specific *Puccinia* species attack diffuse knapweed in Europe, but so far we have not found a strain that will attack the Canadian genotype.

The importance of vegetative reproduction in most water weeds ensures a high degree of genetic uniformity. Surveys in Yugoslavia have revealed several specialized pathogens of watermilfoil. Due to problems of applying herbicides into water systems, the possibility of controlling watermilfoil with plant pathogens is most attractive.

Endemic Plant Pathogens

A new approach to biological control of weeds has been pioneered in Arkansas against Northern jointvetch. A spore suspension of the endemic fungus *Collectotrichum gleosporioides aeschynomene,* applied early in the season, killed 99 percent of the weed with no damage to the rice crop. This disease was already present, but did little damage to the weed because it normally attacked too late in the season. This technique has also been used with another endemic fungus against teaweed in cotton and soybeans. The fungus normally produced an insignificant stem spot on mature teaweed. But when applied early, it produced a devastating seedling blight.

A target for weed control with endemic plant pathogens in Canada is wild oats. Cultural and chemical control methods can reduce wild oats to tolerable levels, but it remains the most expensive and serious weed problem in the grain growing belt of the prairies. Wild oats is attacked by an array of diseases. These diseases ordinarily develop too late in the season to do appreciable damage to wild oats in Canada. The solution is to inoculate early in the spring with a host specific pathogen. The most promising source is the genus *Helminthosporium* which contains host specific species. For example, *H. victoriae* is specific to the oat cultivar Victoria and to those varieties derived from crosses with Victoria oats.

An attractive feature of the method is that it would not involve intro-

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[1] Reproduction by specialized generative tissues, but not dependent upon sexual reproduction.

ducing any new pathogens, but merely the use of existing host specific pathogens at a time when they are most effective. In contrast to herbicides, direct application of a pathogen to a weed is not necessary for control as the pathogen will increase and spread from the inoculation foci. Although cost is not known, this is a considerable economic factor in the favor of phytopathogenic weed control.

Weed Control with Nematodes

Nematodes also have potential for use as biological herbicides. The nematode, *Paranguina picridis,* is being investigated at the Regina Research Station for the biological control of Russian knapweed. Russian knapweed is a herbaceous perennial weed widely distributed in Canada. It is native to southern Russia and Asia Minor and was introduced with Turkestan alfalfa around 1900.

Nematode galls on Russian knapweed

In North America, the weed is almost free from natural enemies, but in its native range it is attacked by several specialized parasites. *P. picridis* was imported (under quarantine) into Canada for investigation as a potential biocontrol agent for Russian knapweed. Infected plants are distorted with growth and seed production greatly reduced. The Russians reported 100 percent infection and 80 percent destruction of the knapweed and are utilizing the nematode as a biological control agent. It can be applied like a granular herbicide and has a long shelf life if kept dry: the experimental stock used at Regina is over 10 years old and is still viable.

Laboratory tests have shown that the host range is restricted to the thistle tribe of the Compositae family. This tribe includes two economic plants — safflower and globe artichoke. Further studies are necessary to determine whether this will exclude the use of the nematode in North America.

Objections

There are two objections to the proposed use of pathogens against wild oats. The first concern is that pathogens do not have a sufficient level of specificity to prevent them from damaging cultivated oats. This is a possibility, but our proposal is to investigate the host range of the pathogens on wild oats already in Canada. No additional pathogens would be introduced. If those already here do attack cultivated oats in host tests, the project would end. The situation in the field is unchanged except that more is known about the role of wild oats as a reservoir of crop pathogens.

The second concern is that the use of the pathogen would increase the number of mutations and hence the probability of a new race harmful to cultivated oats. This concern has some validity as the number of mutations in a pathogen is a function of the number of spores produced. If the result of applying a pathogen on wild oats early in the spring increases the total number of spores produced throughout the summer, the number of mutants will also be increased. On the other hand, if the pathogen is going to be useful, it must kill the wild oat plants early in the spring, as happened with Northern jointvetch and teaweed in Arkansas. The result should be a reduction in the number of spores produced as there will be fewer mature wild oat plants at the end of the summer.

Possibly the real and unstated objection to the use of a pathogen as a tool is the deep-seated fear of pathogens by both the scientist and layman. This was very apparent before their use against skeleton weed in Australia. The only answer is to expose the proposal for wide and rational discussion.

The use of plant pathogens as 'biological' herbicides that can be applied with conventional equipment when the weed is most susceptible will extend the targets for biological control to wild oats and other major weeds. The preliminary studies required to demonstrate that this proposal is a viable approach to weed control includes surveys to determine what endemic pathogens are attacking weeds and testing to determine the host range of these organisms. ■

INCREASING LAMB PRODUCTION BY SELECTION

J. A. VESELY

Selon les chercheurs de la Station de recherche de Lethbridge, la sélection peut permettre d'améliorer de façon raisonnable les aptitudes de production des moutons même si la variation génétique est modérément faible. Pour améliorer génétiquement un troupeau, il faut sélectionner les agneaux dont le rendement est supérieur à la moyenne des autres sujets du troupeau. Les béliers peuvent réaliser des progrès génétiques plus rapides, car plus la variation à la sélection est marquée, plus l'amélioration génétique est importante.

A breeder can use genetics in two ways to improve production traits. First, he can carefully select the individuals to be used as parents and, second, he can control the way in which the parents are mated by crossbreeding. Gains in production by crossbreeding are relatively easier to determine. Any sheep producer can raise both purebred and crossbred lambs on his farm and measure the difference in production between the two groups. However, improvement in production by selection is much more difficult to measure and the techniques used for measuring genetic trends are much more sophisticated and not easily understood by the average sheep producer. Very few breeders of pure livestock know how much genetic improvement has been made in their animals over a period of years or over the lifetime of the breeder.

At the Manyberries Substation of the Lethbridge Research Station, we conducted an experiment designed to measure the response to selection for one trait only (weight-per-day-of-age, WPDA) and also to determine correlated responses of other traits (weaning weight, WW; and post-weaning gain, PWG) in two breeds of sheep (Rambouillet, Romnelet). The foundation flocks for this study consisted of 150 Rambouillet and 150 Romnelet ewes.

The sheep were maintained in the experiment from 1966 to 1970 under range conditions at the Manyberries Substation. Breeding was scheduled each year from November 15 to December 19. All lambs were weighed at weaning on August 8 and then fed a pelleted ration individually for 70 days. The ration was as follows: alfalfa hay, 61.5 percent; molasses, 10 percent; barley, 28 percent; monosodium phosphate, 0.25 percent; salt (cobalt-iodized), 0.25 percent; and 1 million IU of vitamin D per ton. Replacement ram and ewe lambs were selected within breed and sex for WPDA at the end of the postweaning feeding trial (average age 170 days). Ewes were replaced with lambs at death, or because of faulty udders or "broken" mouths, if barren in 2 successive years; or when 6.5 yr old. The flocks were maintained at a constant size of 150 ewes.

Estimating genetic change is not easy and the methods used are relatively new. For accuracy, this experiment was designed to use two methods of measuring genetic change. A brief description of the methods will demonstrate that to measure genetic change, the breedings must be planned and adhered to throughout the experimental period.

Method I measured the genetic change by the difference between the linear regression of performance on time for the breed concerned and the pooled within-sire regression of progeny performance on time. Method II used repeated matings to estimate environmental change. These repeated matings gave two groups of full sibs (lambs having the same father and mother) born in successive years. The means from the full sibs were used to estimate evironmental differences between years. The response from selection was measured as a difference, in intra-year comparisons, between means of progenies of selected sires and means of environmental trend.

Selection Differential

For a breeder to genetically improve his flock, he must select lambs that are superior in performance to the average for all lambs in the flock. The difference between the average performance of the selected lambs and that of all lambs is called selection differential.

The results demonstrate that more rapid genetic progress can be made

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by rams since the greater the selection differential, the greater the genetic improvement (Table 1). The largest possible selection differential would be obtained if only the best animal were selected. When there are two, three, or more animals selected, the maximum selection differential is reduced accordingly. Since in this experiment, on the average, only 6 ram lambs and 33 ewe lambs were selected within breed every year, the male selection differentials are much higher. The selection differential of Rambouillet ram lambs in year 1 implies that, for example, if the average WPDA of all Rambouillet ram lambs in that year was 0.60 lb, the average WPDA of the selected ram lambs was 0.71 lb.

TABLE 1 WEIGHTED SELECTION DIFFERENTIALS FOR WEIGHT-PER-DAY-OF-AGE (WPDA, LB) IN FOUR LAMB CROPS OF TWO BREEDS

	Rambouillet		Romnelet	
Year	♂	♀	♂	♀
1	0.11	0.00[1]	0.08	0.03
2	0.12	0.04	0.07	0.04
3	0.12	0.03	0.07	0.05
4	0.15	0.04	0.12	0.05

[1] Zero selection differential because the selected females did not raise any lambs that year.

TABLE 2 YEARLY MEANS OF WEIGHT-PER-DAY-OF-AGE (WPDA, LB), WEANING WEIGHT (WW, LB), AND POSTWEANING GAIN (PWG, LB)

	Rambouillet			Romnelet		
Year	WPDA	WW	PWG	WPDA	WW	PWG
1	0.52	64.0	28.8	0.49	62.5	27.7
2	0.48	56.5	33.7	0.46	54.8	31.5
3	0.55	59.4	40.9	0.52	57.4	39.4
4	0.57	62.5	41.8	0.56	62.5	41.6
5	0.60	62.7	43.1	0.58	58.1	43.6

Genetic Trend

Genetic improvement cannot be obtained from the absolute measurements collected from year-to-year because the performance can be greatly influenced by environment. Some progress was made in WPDA and PWG but apparently none was achieved in WW (Table 2). Even the gains in WPDA and PWG were not entirely genetic gains.

Genetic Gain

By knowing the degree of heritability and the selection intensity applied (selection differential), it is possible to estimate expected response from selection. This was done for the traits studied in this experiment and the obtained values compared to the responses measured by the two methods (Table 3).

The expected and measured responses are very similar. For example, in Rambouillet the expected and measured response was about 0.02 lb/yr. This means that, if the average WPDA of the flock at the beginning of the experiment was 0.50 lb, after 5 yr of selection the average WPDA in the flock would be 0.60 lb. The measured correlated responses in PWG are in agreement with the expected responses. Values for WW are somewhat variable, probably because it can be easily influenced by environment. It appears that the methods used did not remove the environmental variation entirely. Nevertheless, although selection was practised on WPDA, positive correlated gains were also achieved in WW and PWG.

TABLE 3 ANNUAL EXPECTED AND ESTIMATED RESPONSES TO SELECTION FOR WEIGHT-PER-DAY-OF-AGE (WPDA) AND CORRELATED RESPONSES IN WEANING WEIGHT (WW) AND POSTWEANING GAIN (PWG)

Method of calculation	Rambouillet, lb			Romnelet, lb		
	WPDA	WW	PWG	WPDA	WW	PWG
Expected	.015	1.10	1.25	0.012	0.66	1.12
Method 1	.021	2.42	1.41	0.013	2.64	0.99
Method 2	.020	1.32	1.23	0.017	1.98	0.92

Limits of Selection

Reasonable gains in production can be obtained by selection even if only a moderately small genetic variation exists. However, improvement was achieved with the maximum selection intensity possible, retaining each year in each breed, on the average, 4 percent of the males and 22 percent of the females. Response to selection over several generations gives no indication of the unknown limits of artificial selection.

Tentative answers to selection limits can be drawn, probably with some degree of error, from studies with laboratory animals such as mice and rats. Results of long-term experiments with mice for up to 80 generations can be equivalent to studies for 200 yr with sheep. By applying knowledge from such experiments to the results of this experiment, it can be postulated that an annual response of 0.02 lb in WPDA could continue in the two experimental flocks for 13 to 39 yr, which would be equivalent to 5 to 16 generations.

Some of the methods for estimating genetic change, for example Method I, are not as complicated as they appear. It is possible under minimum guidance to measure genetic improvements on a national, provincial, and individual flock basis. ■

ECHOES
FROM THE FIELD AND LAB

CROP INSURANCE ON THE UPSWING Crop insurance is rapidly gaining favor with Canadian farmers. Over 100,000 farmers have about $1 billion of insurance on their crops in 1975-76. This is an increase of about 20 percent more farmers with about 50 percent more insurance than in 1974-75

According to G. M. Gorrell, Director of Crop Insurance, Agriculture Canada, there are several reasons for the increase. High input costs, especially for fertilizers, herbicides, fuel and machinery, have made farmers more aware of the need to protect their investment. Weather conditions also played a role. In 1974, early fall frosts and heavy spring rains played havoc with crops across Canada, making farmers more conscious of the need for increased protection. Mr. Gorrell feels, though, that it is perhaps just the general education towards crop insurance that the provinces have undertaken that is being reflected. Also, he says that it is more of an accepted management practice among farmers than it was a few years ago.

IRRIGATED RAPESEED CROPS Farmers in southern Alberta now have more answers to their questions about irrigating rapeseed crops. Studies by Ken Krogman, an irrigation agronomist at the Lethbridge Research Station, show that maintaining ample soil moisture through the growing season more than doubles yields and increases the oil content of seeds.

The tests started in 1971 involved four treatments: no irrigation; irrigating only in June; irrigating until the plants flowered; and irrigating until harvest. The scientists found that rapeseed keeps responding to water until harvest. On this basis, the scientists now recommend irrigating rapeseed through to harvest, although this may not be necessary on heavier soils. Mr. Krogman notes that the important thing is that there is adequate moisture in the soil.

GROWING TOMATOES AND POTATOES In response to the demands of backyard gardeners, Dr. Calvin Chong of the Ornamentals Research Service, Ottawa, has written two separate booklets that describe the basics of potato and tomato cultivation. The booklets introduce the novice to the essentials of seeding, growing, harvesting and storing. They are entitled *Growing Garden Tomatoes,* Publication 1558, and *Growing Garden Potatoes,* Publication 1559. Copies can be obtained from the Information Division, Agriculture Canada, Ottawa, K1A 0C7.

TO CAN OR NOT TO CAN? That's the question many homemakers are asking themselves. A new publication, *Canning Canadian Fruits and Vegetables,* answers many of the questions on canning that have perplexed the home-canning enthusiast.

Canning is an economical way of preserving high quality fruits and vegetables when they are plentiful. But to be successful, there are seven important steps to follow. The publication makes recommendations on these basic steps: select equipment; prepare containers; select and prepare fruits and vegetables; pack the food in suitable containers; process to kill spoilage organisms; seal and cool; then label and store. In addition, the publication contains specific instructions on selection and processing for individual fruits and vegetables.

Canning recommendations have remained basically the same over the years. However, because of the low-acid tomatoes now on the market, the method for canning tomatoes and tomato juice has been changed. A small amount of citric acid is now added to tomatoes before processing.

There is only one way to can and that's the right way. A free copy of publication no. 1560 can be obtained from the Information Division, Agriculture Canada, Ottawa, K1A 0C7.

FAIRE OU NE PAS FAIRE DE CONSERVES? C'est la question que se posent un grand nombre de gens. A cette fin, une nouvelle publication intitulée "La mise en conserve des fruits et légumes" répond à plusieurs des questions qui préoccupent depuis longtemps les mordus.

La mise en conserve constitue une façon économique de conserver les fruits et les légumes de haute qualité en période d'abondance. Toutefois, pour une mise en conserve réussie, il faut compter sept étapes importantes, soit choisir l'outillage, préparer les récipients, sélectionner et préparer les fruits et les légumes, verser les aliments dans des contenants appropriés, stériliser pour détruire les micro-organismes nuisibles, sceller et refroidir, et finalement étiqueter et emmagasiner. En plus de faire des recommandations sur ces étapes de base, la publication renferme des instructions particulières sur le choix et la transformation de chaque espèce de fruit et de légume.

Les recommandations sur la mise en conserve sont demeurées fondamentalement les mêmes au cours des années. Toutefois, vu la faible teneur en acide des tomates actuellement mises au marché, la méthode de mise en conserve des tomates et du jus a été modifiée. Une petite quantité d'acide citrique est maintenant ajoutée aux tomates avant la transformation.

Il n'y a qu'une façon de réussir, c'est la bonne façon. On peut obtenir un exemplaire gratuit de la publication nº 1560 auprès de la Division de l'information, ministère de l'Agriculture du Canada, Ottawa K1A 0C7.

NEW POTATO BREEDING SUB-STATION A new Agriculture Canada potato breeding sub-station has been opened at Benton Ridge, N B. The sub-station will be Canada's center for potato breeding. Scientists based at the Fredericton Research Station will direct the research projects at Benton Ridge.

The 850 ac sub-station has 150 ac of good arable land typical of N B. potato soils. The remaining 700 ac is wooded, and acts as a buffer against the spread of diseases and insects from neighboring farms. Also, stringent precautions exist to prevent disease organisms from entering the area. All machinery and implements must be steam-sterilized before entry, and protective clothing is provided for staff and visitors.

Research plots will be used for both selection of superior potato varieties for domestic uses, and multiplication of seed stock. The new sub-station has facilities for potato storage, grading and handling, machinery storage, carpentry maintenance, laboratories and meeting rooms.

NEW USES FOR PEACH AND APRICOT PITS Complete use of all parts of the Okanagan stone fruit crop is a step closer with the establishment of a company which processes peach and apricot pits. The CDA Research Station at Summerland, B C., assisted the processor with advice on equipment to clean, dry and separate kernels from the stony pericarp.

The inedible stony pericarp is ground to make an additive for oil well drilling. The kernels are also an excellent source of oil which is a valuable ingredient in skin creams, and other cosmetics. The remaining pulp from the kernel is a good source of plant protein. With further treatment to remove the bitter tasting component, amygdalin, it may be a useful ingredient in animal feed.

In the past, most pits from stone fruits canned in B.C. were disposed of in city and municipal dumps. This new processing development represents one more step in complete utilization of agricultural wastes

ECHOS
DES LABOS ET D'AILLEURS

Agriculture Canada's New Crop Development Fund will assist scientists in developing new varieties of rapeseed that have a higher yield per bushel and seed yield per acre.

FUNDS FOR RAPESEED DEVELOPMENT The Rapeseed Association of Canada will receive $446,919 from Agriculture Canada's New Crop Development Fund for a 3-year project aimed at improving the yield and quality of low-erucic acid rapeseed in the three prairie provinces.

The development program, supervised by the Rapeseed Association, will be carried out by Dr. Z. P. Kondra at the University of Alberta, Dr. R. K. Downey, an Agriculture Canada scientist working with the University of Saskatchewan, and Dr. B. R. Stefansson at the University of Manitoba. Dr. Downey and Dr. Stefansson recently received the 1975 Royal Bank award for their work in developing improved strains of rapeseed.

Earlier research on rapeseed dealt with the urgency to provide a low erucic acid and low glucosinolate variety to produce an edible oil suitable for human consumption and animal feeds. This project will be aimed at increasing oil yield per bushel and seed yield per acre. The scientists will also be trying to decrease the maturity period raise the linoleic acid level above 30 percent, and develop disease-resistant varieties. They plan to have seeds licensed and ready for commercial production by the end of the 3-year period.

INSECT IDENTIFICATION SERIES The Information Division, Agriculture Canada, will soon be releasing the first leaflets of a new insect identification series. By 1977, 100 leaflets, each on one of the major pests in fruits, vegetables, field crops and livestock, will have been issued. The information leaflets will be bilingual and will help commercial producers and hobbyists to identify destructive pests. The life cycle of the pest, and the damage it causes the host, are illustrated in color.

The three-color printing process, adapted by G. H. Parker of the Information Division will be used to produce the leaflets. The quality of reproduction possible with this inexpensive technique is very high.

The identification leaflets will be listed in the index of publications and single or bulk quantities of copies will be available on request from the Information Division, Agriculture Canada, Ottawa, K1A 0C7.

INTERNATIONAL WOMEN'S YEAR 1975 Agriculture Canada has been active this year in publicizing the opportunities open to women in agriculture. The Information Division, with the aid of experts in the many disciplines of the department, has produced a brochure, developed a film and organized an eight-panel display. The display was first exhibited at the well-known Salon de la Femme in Montreal last May, and has been located at several other major fairs throughout the country during the summer and fall.

The booklet, "Women in Agriculture", summarizes several of the many areas in agriculture where women and men find rewarding employment. It is available upon request from the Information Division, Agriculture Canada, Ottawa, K1A 0C7.

LIMITS TO PRODUCTIVITY The Research Branch, Agriculture Canada, has released two monographs that outline and describe the actual and potential agricultural productivity of land in eastern Canada. The author, Dr. John L. Nowland, Soils Research Institute, has systematically identified the class and location of soils and explained the constraints placed on them.

The publications conclude that present farm land in Ontario could produce 116 percent more food, in Quebec 25 percent more, and in the Maritimes 800 percent more. However, there are limitations that could prevent such increased productivity. In the Maritimes, these limitations include soil characteristics, climate, social attitudes, and economic conditions. In Ontario and Quebec, irreversible destruction of land by urbanization limits full production potential. Dr. Nowland estimates that between 1971 and 2001, 12 percent of the food producing capacity of Ontario and 26 percent in Quebec may be lost to attrition.

These monographs may be obtained by requesting Monograph 12, *The Agricultural Productivity of the Soils of the Atlantic Provinces*, and Monograph 13, *The Agricultural Productivity of the Soils of Ontario and Quebec*, from the Information Division, Agriculture Canada, Ottawa, K1A 0C7.

THE SMELLY FEEDLOT IS YOUR FRIEND The familar odor of a feedlot means wholesome food for Canadians. Livestock production in feedlots is an efficient way of converting grain and forages to meat. However, the major waste product, manure, is concentrated in the feedlot, creating unpleasant odors when the manure begins to decompose.

Despite public complaints, feedlot odors are not deadly, but the microorganisms that grow in manure could be a health hazard. Studies by scientists at the Lethbridge Research Station in cooperation with commercial feedlots have shown that many fungi can develop in beef cattle manure. Some of these cause cattle diseases and others are poisonous.

In laboratory conditions, fungi can develop on manure to a potentially dangerous level in a few weeks, but this does not happen in southern Alberta feedlots. According to Dr. Graham Bell, Lethbridge Research Station, Alberta's cold winters and dry summers severely restrict fungal growth. However, in areas where summers are hot and wet, the fungi may develop almost unchecked, posing a health hazard to cattle and humans.

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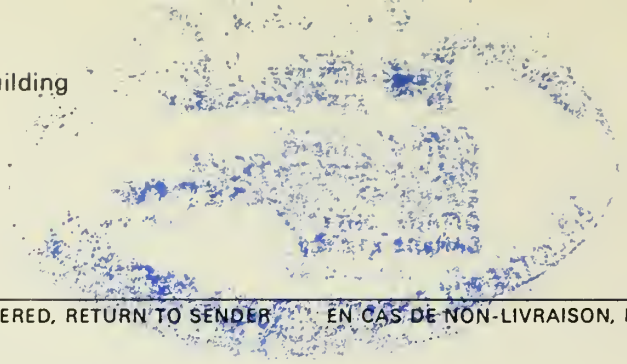

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